TECHNICAL REPORT NO. 74-16

105mm SUBCALIBER TRAINING DEVICE

Final Report

By
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Munitions Branch

February 1974

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U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

REPORT DOCUMENTATION PAGE

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Training Device
Tank Gunnery
Firing Control Training Device
Armor Crew Training

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This is the final Report of the 105mm Subcaliber Training Device program. The purpose of this program was to design, test, and demonstrate feasibility of a Subcaliber Training Device which could be fired from the 105mm M68 Gun on the M60 and M60A1 Tanks. The Training Device would be used in training exercises where the actual round could not be used because of safety requirements.

(continued)

Continuation of Block 20:

The Training Device approximates the actual 105mm Round in size and weight. It consists of a .50 Caliber Spotting Rifle barrel and a specially designed bolt and breech mechanism inside a simulated 105mm shell body. The Caliber .50 M48A1 Spotter Tracer Round is fired from this simulated shell using the 105mm M68 Gun firing system on the M60 Tank. Compensation for the initial velocity difference (1780 fps versus 2400 fps) is accomplished by a special cam for the M13 Tank Gunfire Range Computer.

The final design was evaluated by 1st Armored Division in Germany and the results of these tests are included in this report.

FOREWORD

This program was conducted by the US Army Land Warfare Laboratory in response to a request from the Commanding General, USAREUR, for a 105mm training device. The 105mm Subcaliber Training Device Program was conducted under LWL Task 07-F-70 as authorized by DA R&D Project 2X663701D718.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

INTRODUCTION

Armored Forces in Europe are being more and more restricted in training exercises which use 105mm Rounds because of the reduction and restriction of ranges where the full-size rounds may be safely fired.

This training device simulates the operation and trajectory of the 105mm HEP-T Round. It is a self-contained unit with the same shape and weight as a regular shell and is fired from the M68 Gun System on the M60 Tank without modification to the gun, tank or firing system. The device was developed to allow training to be conducted in areas which have range limitations that do not permit main gun firing. In addition, the Subcaliber Device costs approximately $1.00 for each firing, while the full-size rounds cost approximately $70.00 to $80.00 each.

DEVELOPMENT AND TESTING

1. General

In April 1970, the Commander, USALWL, visited USAREUR and the Commander of USAREUR indicated a need for a Subcaliber Training Device which would allow training at bases where the firing ranges were too short or too restricted to allow firing of the full-size 105mm rounds.

In June 1970, USALWL Project 07-F-70, 105mm Subcaliber Training Device was initiated. The original request was for a Caliber .50 M48A1 Spotter Tracer Round which would be modified or uploaded so that its velocity and trajectory would match the 105mm HEP-T Round out to 1500 meters. Investigation into this approach indicated that the round could not be significantly uploaded without increasing its volume. In addition, the barrel was too thin for any substantial increase in the gas pressure.

The cost of developing and testing a new or modified Caliber .50 Round appeared to be so prohibitive that this approach was discarded.

An investigation into training rounds of different calibers and the British L11A2 Spotter Tracer Round resulted in the decision to use the standard Caliber .50 M48A1 Spotter Tracer Round with a modification to the range cam in the M13 Gunfire Range Computer to compensate for the lower velocity.

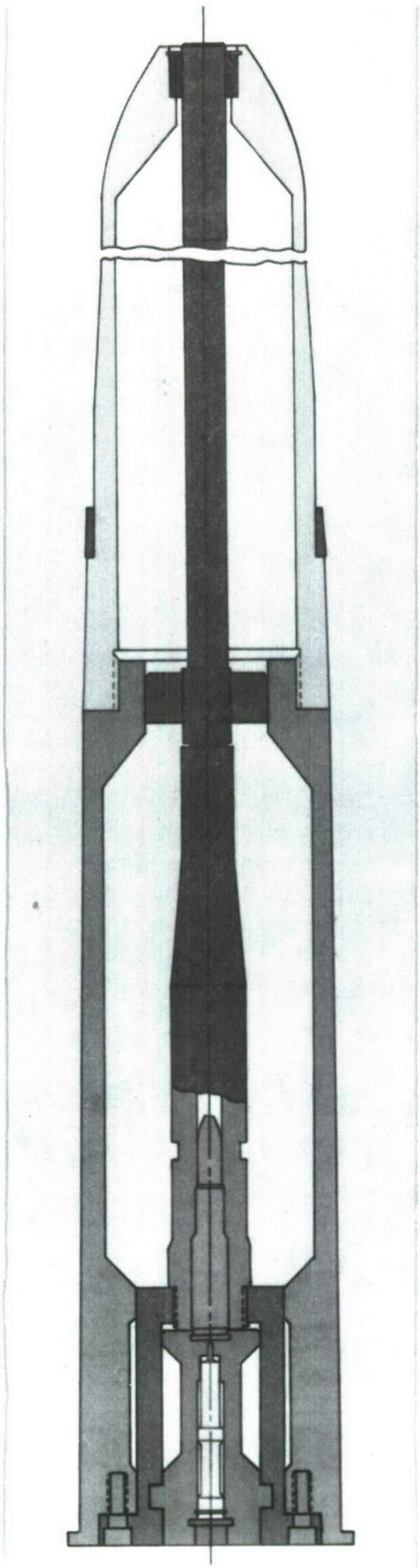
2. Description of Designs

A first design was completed (see Figure 1) and tests were started in December 1970. These tests, recorded in Appendix A, indicated a need to reduce the tolerance build-up between the component parts of the subcaliber barrel and the locating dimensions on the exterior diameters. In addition, the test firings indicated that decomposition products from the electrically initiated primer was causing residue to build up in the tube. After 10 to 20 shots, the firing pin in the bolt assembly tended to jam because of the carbon build-up.

A second design with three modifications was fabricated. These modifications included:

a. A chamber into which the primer discharged and from which the gas pressure was vented into the firing pin.

b. A component redesign so that the tolerance build-up between the subcaliber barrel and the mounting dimensions on the exterior of the training device was reduced by two-thirds. This was accomplished by combining two mating parts into one piece in a number of cases and reducing the tolerance on the other pieces.



105 MM SUBCALIBER TRAINING DEVICE

FIGURE 1

c. A safety feature which required that the bolt be rotated and locked in firing position before the insertion tool could be removed. This final design is shown in Figure 2. The bolt design is shown in Figure 3.

This new design never jammed from residue build-up even after several hundred firings. However, for maintenance purposes it was recommended that the bolt assembly be disassembled and cleaned after each day's firing.

3. Cam Design

The gunfire range cam was designed using the following information from FCDD-305, Department of the Army Notes on Development Type Material, Primary Fire Control System Tank, 90mm Gun, M48, pages 66-103 (this section of the report dealt with the M13 Gunfire Range Computer for the 105mm Gun). A copy of this report is available at the Aberdeen Proving Ground Technical Library.

$$D = 1.7782 - \frac{X^{o}\ (.2655)}{122.3^{o}}$$

$$X^{o} = 61.78 - 327.4068854 \quad \log e \quad (1.5 - e^{0.1749987(2\ \log_e R - 3.11528)})$$

Where: D = Diameter of Cam

R = Range, in 1000 yards

X = Angle of Cam Travel (at 0^{o}, D = 1.7782")

The range is related to the mils superelevation of the gun by the constant:

3^{o} cam rotation = 1 mil superelevation

or

1^{o} cam rotation = 1/3 mil superelevation

Then when the range/mils superelevation relationship (firing table) is known for any shell or bullet, a cam which will give the proper superelevation of the gun for the desired range (which is input into the M13 Gunfire Range Computer through the range dial on the computer) can be designed.

A computer runout showing the relationship between range, cam angle, gun superelevation, and the diameter "D" of the gunfire range cam was used for designing the cam. The following chart shows how the cam design was constructed:

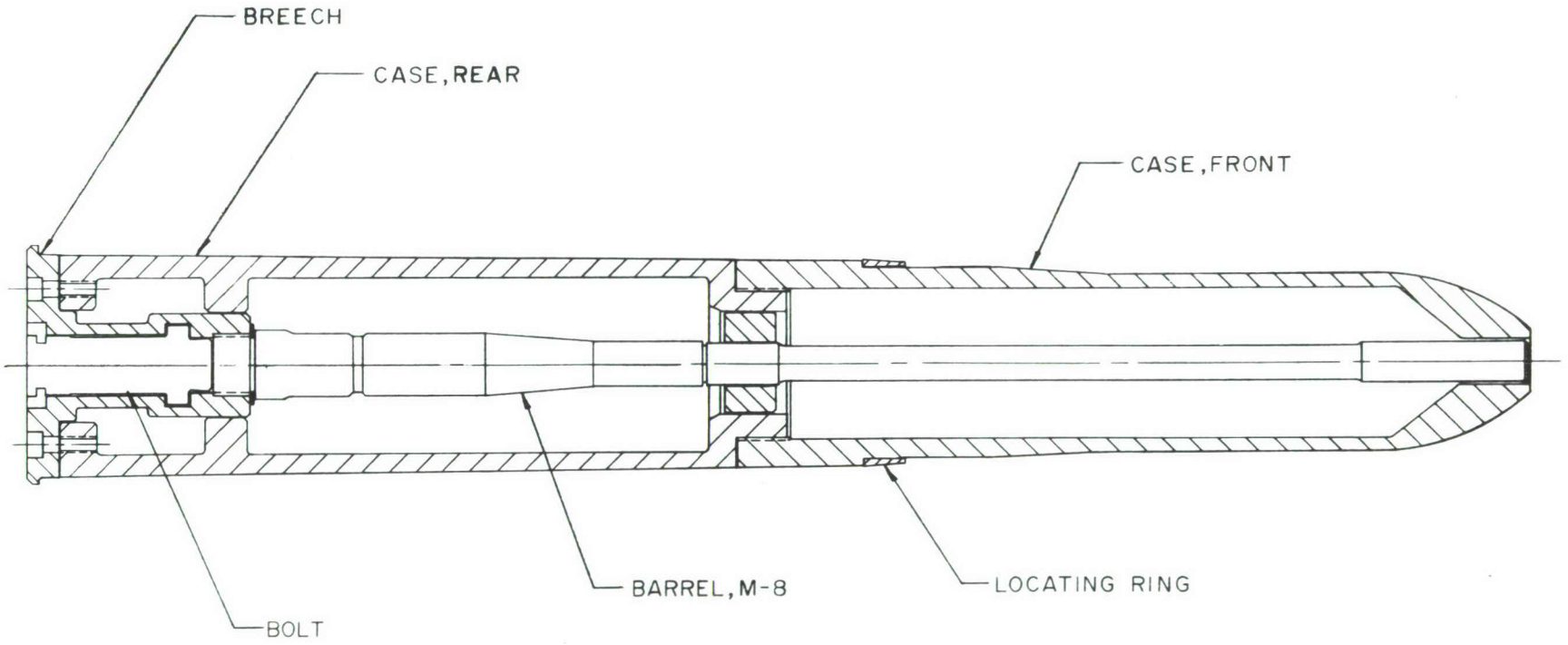


FIGURE 2. 105mm SUBCALIBER TRAINING DEVICE

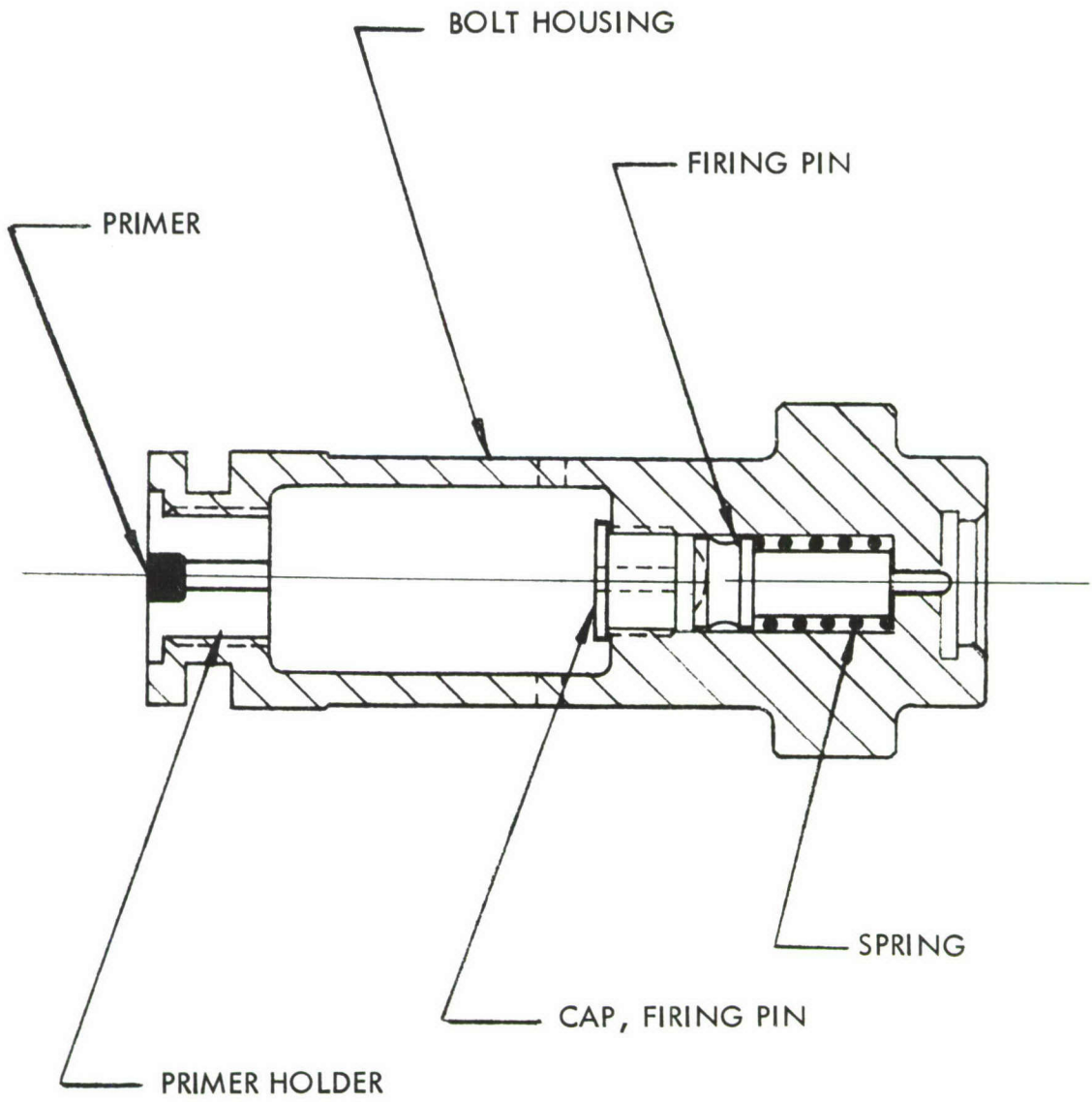


FIGURE 3. BOLT

Construction of Cam Design

Table 1

Step	X Cam Rotation Degree	Range Yards	Elevation Mils	Diameter "D"	Drop D_1-D_2	Difference
0	-11^{o}	0	0	1.8525	-	-
1	-10^{o}	24.942	1/3	1.8525	0	0
2	-9^{o}	43.761	2/3	1.8338	.01860	.01860
3	-8^{o}	62.404	1	1.8198	.03270	.01409
4	-7^{o}	80.873	1-1/3	1.8081	.04437	.01167
-	-	-	-	-	-	-
11	0^{o}	205.43	3-2/3	1.7537*	.09737	.00612

* At 0^{o} on the cam this value would normally be 1.7782 but it was moved back 3^{o} to cause the superelevation produced by the cam to more nearly agree with the superelevation actually used when conducting accuracy and dispersion firings at a range of 1500 yards.

The cam detail is shown in Figures 4 and 5.

The cam was made and tested from 500 to 1500 meters. Since we had the mils superelevation used when firing accuracy and dispersion test at 500 and 1500 yards, a comparison of elevation used when firing at these two distances were made:

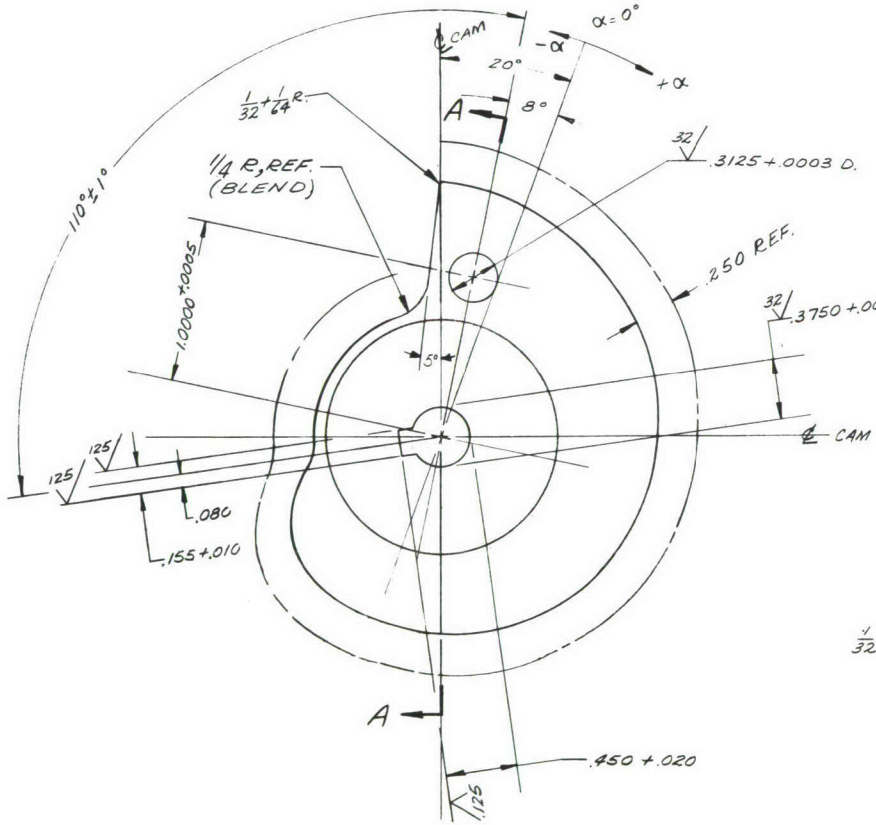
Comparison of Elevation

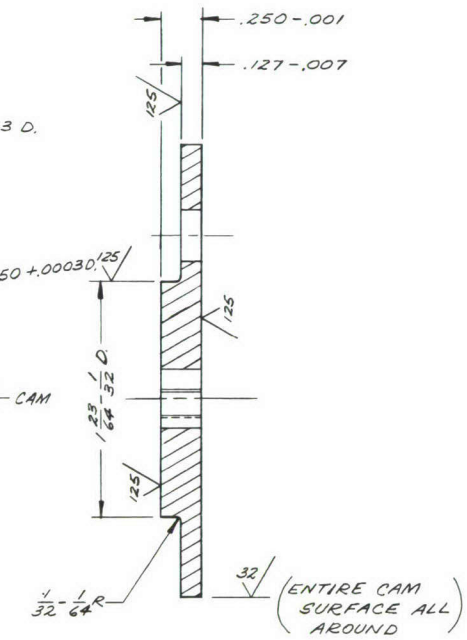
Table 2

Range Yards	Firing Table Elevation Mils	Mils Used When Firing	Difference
500	9.8	8.3	1.5 mils
1500	41.5	39.8	1.7 mils

Using these results, the cam zero or starting point was "moved back" approximately 1.5 mils so that the following relationship was developed. It was assumed that this adjustment was required to compensate for the increased muzzle velocity which resulted when the barrel pressure bleed hole was blocked off.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED





SECTION A-A
SCALE 2/1

Notes:

1. Cam dimensions shown on Sheet 2 of 2.
2. "D" is the radial distance from the center of the cam to the center of a 1/2" diameter cutter. The tolerance on "D" will be ±.002 for all values of α except as shown below.
   ±.0003 at α = -8° to +90°
3. Drop "D" is the radial displacement of a 1/2" diameter cutter from a 3.6336 diameter base circle (ref.)
4. The tolerance on α at all positions is ±0° 4'.

QTY	PART NO.		PART NAME	STOCK SIZE	MATERIAL	SPEC	ITEM
			UNLESS OTHERWISE SPECIFIED				

DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± ——— DECIMALS ± .005 ANGLES ± 1°

MATERIAL: S'STEEL, RD. TYPE 440C 3 1/2" DIA.

FINISH: PASSIVATE PER FINISH NO 5.4 OF MIL-STD. 171

HEAT TREATMENT: Rc 55 - 60

ORIGINAL DATE OF DRAWING: 26 APR. 71

DRAFTSMAN	KDK	4/26/71
CHECKER		
PROJECT ENG.	[redacted]	5/5/71
PROJECT NO.	07-F-70	

APPROVED ——— DATE

QTY	NEXT ASSY	USED ON

APPLICATION

[redacted]
ABERDEEN PROVING GROUND, MARYLAND 21005

U. S. ARMY LAND WARFARE LABORATORY

CAM

SIZE	CODE IDENT. NO.		REV.
C		040087016	

SCALE 2/1 SHEET 1 OF 2

040087016

11

COL. 1	2	3	4
α	"D"	DROP "D"	DIFF.
1 -20°	1.8525	0	0
2 -19°	↑	↑	↑
3 -18°	↑	↑	↑
4 -17°	↑	↑	↑
5 -16°	↑	↑	↑
6 -15°	↑	↑	↑
7 -14°	↑	↑	↑
8 -13°	↑	↑	↑
9 -12°	↓	↓	↓
10 -11°	1.8525		
11 -10°	1.8339	.0186	.0186
12 - 9°	1.8198	.0327	.0141
13 - 8°	1.8081	.0444	.0117
14 - 7°	1.7980	.0545	.0101
15 - 6°	1.7890	.0635	.0090
16 - 5°	1.7808	.0716	.0082
17 - 4°	1.7733	.0791	.0075
18 - 3°	1.7664	.0861	.0070
19 - 2°	1.7599	.0926	.0065
20 - 1°	1.7534	.0987	.0061
21 0°	1.7480	.1045	.0058
22 1°	1.7424	.1100	.0055
23 2°	1.7372	.1153	.0053
24 3°	1.7322	.1203	.0050
25 4°	1.7274	.1251	.0048
26 5°	1.7227	.1298	.0046
27 6°	1.7183	.1342	.0045
28 7°	1.7140	.1385	.0043
29 8°	1.7098	.1427	.0042
30 9°	1.7057	.1467	.0040
31 10°	1.7019	.1506	.0039
32 11°	1.6981	.1544	.0038
33 12°	1.6944	.1581	.0037
34 13°	1.6908	.1617	.0036
35 14°	1.6873	.1652	.0035
36 15°	1.6839	.1686	.0034
37 16°	1.6806	.1719	.0033
38 17°	1.6774	.1751	.0032
39 18°	1.6742	.1783	.0032
40 19°	1.6711	.1814	.0031
41 20°	1.6681	.1844	.0030
42 21°	1.6652	.1873	.0030
43 22°	1.6623	.1902	.0029

COL. 1	2	3	4
α	"D"	DROP "D"	DIFF.
44 23°	1.6594	.1931	.0028
45 24°	1.6567	.1958	.0028
46 25°	1.6539	.1986	.0027
47 26°	1.6513	.2012	.0027
48 27°	1.6486	.2038	.0026
49 28°	1.6461	.2064	.0026
50 29°	1.6430	.2089	.0025
51 30°	1.6411	.2114	.0025
52 32°	1.6362	.2162	.0048
53 34°	1.6316	.2209	.0047
54 36°	1.6271	.2254	.0045
55 38°	1.6227	.2298	.0044
56 40°	1.6184	.2341	.0042
57 42°	1.6143	.2382	.0041
58 44°	1.6103	.2422	.0040
59 46°	1.6064	.2461	.0039
60 48°	1.6026	.2499	.0038
61 50°	1.5989	.2536	.0037
62 52°	1.5953	.2572	.0036
63 54°	1.5918	.2607	.0035
64 56°	1.5883	.2642	.0034
65 58°	1.5850	.2675	.0034
66 60°	1.5817	.2708	.0033
67 62°	1.5785	.2740	.0032
68 64°	1.5753	.2772	.0031
69 66°	1.5722	.2802	.0031
70 68°	1.5692	.2833	.0030
71 70°	1.5663	.2862	.0030
72 72°	1.5634	.2891	.0029
73 74°	1.5605	.2920	.0028
74 76°	1.5577	.2948	.0028
75 78°	1.5550	.2975	.0027
76 80°	1.5523	.3002	.0027
77 82°	1.5496	.3029	.0027
78 86°	1.5444	.3081	.0051
79 90°	1.5394	.3131	.0050
80 94°	1.5345	.3180	.0050
81 98°	1.5297	.3227	.0047
82 102°	1.5251	.3274	.0047
83 106°	1.5206	.3319	.0045
84 110°	1.5161	.3364	.0045
85 114°	1.5118	.3407	.0043
86 118°	1.5075	.3449	.0042

COL. 1	2	3	4
α	"D"	DROP "D"	DIFF.
87 122°	1.5034	.3491	.0042
88 126°	1.4992	.3532	.0041
89 130°	1.4952	.3573	.0041
90 134°	1.4912	.3612	.0039
91 138°	1.4873	.3651	.0039
92 142°	1.4835	.3690	.0039
93 146°	1.4796	.3728	.0038
94 150°	1.4759	.3766	.0038
95 154°	1.4721	.3803	.0037
96 158°	1.4685	.3840	.0037
97 162°	1.4648	.3877	.0037
98 166°	1.4612	.3913	.0036
99 170°	1.4577	.3948	.0035
100 174°	1.4542	.3983	.0035
101 178°	1.4507	.4018	.0035
102 182°	1.4472	.4052	.0034
103 186°	1.4438	.4086	.0034
104 190°	1.4405	.4120	.0034
105 194°	1.4372	.4153	.0033
106 198°	1.4339	.4186	.0033
107 202°	1.4307	.4218	.0032
108 206°	1.4275	.4250	.0032
109 210°	1.4244	.4281	.0031
110 214°	1.4213	.4312	.0031
111 218°	1.4183	.4342	.0030
112 222°	1.4153	.4371	.0029
113 226°	1.4125	.4400	.0029
114 230°	1.4097	.4428	.0028
115 234°	1.4070	.4455	.0027
116 238°	1.4044	.4481	.0026
117 242°	1.4044	.4481	.0000
118 248°	1.4044	.4481	.0000
119 ↓	↑	↑	↑
120	↑	↑	↑
121	↑	↑	↑
122	↑	↑	↑
123	↑	↑	↑
124	↑	↑	↑
125	↑	↑	↑
126	↑	↑	↑
127	↑	↑	↑
128	↑	↑	↑
129	↑	↑	↑
130 320°	1.4044	.4481	.0000

COL. 1	2	3	4
α	"D"	Drop "D"	DIFF.
108 206°	1.4227	.4298	.0080
109 210°	1.4080	.4438	.0140
110 214°	1.3867	.4658	.0220
111 218°	1.3507	.5018	.0360
112 222°	1.3007	.5518	.0500
113 226°	1.2507	.6018	.0500
114 230°	1.2007	.6518	.0500
115 234°	1.1507	.7018	.0500
116 238°	1.1007	.7518	.0500
117 242°	1.0507	.8018	.0500
118 248°	1.0400	.8125	.0107
119 254°	1.0400	.8125	.0000
120 ↓	↑	↑	↑
121	↑	↑	↑
122	↑	↑	↑
123	↑	↑	↑
124	↑	↑	↑
125	↑	↑	↑
126	↑	↑	↑
127	↑	↑	↑
128	↑	↑	↑
129	↑	↑	↑
130 320°	1.0400	.8125	.0000

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	MOD. CHART FROM 158° THRU 242°	8/12/71	KDK
B	MOD. CHART FROM -20° THRU 320°	10/4/71	KDK
C	MOD CHART FROM 206° THRU 320°	10/25/72	BJA

(A) (B) (C)

QTY	PART NO.	PART NAME	STOCK SIZE	MATERIAL	SPEC	ITEM
		UNLESS OTHERWISE SPECIFIED				

DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± ~ DECIMALS ± ~ ANGLES ± ~

MATERIAL: SEE SHT. 1

FINISH: SEE SHT. 1

HEAT TREATMENT: SEE SHT. 1

QTY	NEXT ASSY	USED ON
APPLICATION		

ORIGINAL DATE OF DRAWING: 4 MAY 1971

DRAFTSMAN	KDK	5/4/71
CHECKER		
PROJECT ENG.	JDE	5/5/71
PROJECT NO.	07-F-70	

APPROVED DATE

[redacted]
ABERDEEN PROVING GROUND, MARYLAND 21005

U. S. ARMY LAND WARFARE LABORATORY

CAM

SIZE C | CODE IDENT. NO. | 04008701G | REV.

SCALE ~ | SHEET 2 OF 2

12

04008701G

Range Elevation from Cam

Table 3

Range Meters	Original Firing Table Elevation Mils	Modified Cam Design Mils	Superelevation Tank Gun Mils	Bench Check M13 Computer Mils
500	10.9	9.4	9.2	9.2
600	13.4	11.4	11.7	11.9
700	16.2	14.7	14.6	14.9
800	19.2	17.2	17.4	17.7
900	22.6	21.1	20.6	21.3
1000	26.3	24.8	24.0	24.6
1100	30.2	28.7	27.6	28.3
1200	34.1	32.6	31.6	32.4
1300	38.5	37.0	35.8	36.6
1400	43.0	41.5	40.3	41.3
1500	47.5	46.0	45.1	45.9
1600	--	49.8	49.7	50.6

Toward the end of the project, after the muzzle velocity of the M48A1 Round had been established, the Ballistic Research Laboratories (BRL) was asked to give a computer run on the range/elevation relationship for the M48A1 using a muzzle velocity of 1785 fps (vs 1723); this gave the following:

Range Elevation from Firing Tables

Table 4

Range Meters	Old Firing Table 1723 fps Mils	New Firing Table 1785 fps Mils	Difference Mils
500	9.4	9.9	+ .5
600	11.9	12.4	+ .5
700	14.7	15.0	+ .3
800	17.2	17.9	+ .7
900	21.1	21.0	- .1
1000	24.8	24.3	- .5
1100	28.7	27.8	- .9
1200	32.6	31.6	-1.0
1300	37.0	35.5	-1.5
1400	41.5	39.7	-1.8
1500	46.0	44.1	-1.9
1600	49.8	48.6	-1.2

The discrepancy between these two firing tables probably accounts for the range limitation which developed during field testing in Germany where the accuracy of the computer was limited to 1000 meters after zero setting at 800 meters range. With an accurate range/elevation relationship available, the gunfire range cam should be very close, from 500 to 1500 meters after zero set at 800 meters.

As BRL pointed out, their range/elevation relationship is only computed and should be checked out by firing tests to establish an accurate trajectory for designing the gunfire range cam.

4. Testing and Test Results

The test plan for the Engineering Design Tests (EDT) is presented in Appendix A.

The results of the EDT are contained in Report No. APG-MT-4001, "Engineer Design Test of Training Device: Subcaliber Ranging/Spotting HEP-T 105mm Round for M60 Tank Final Letter Report," by John T. Matsco, December 1971.

The EDT results indicated that the Subcaliber Device was safe for field evaluation.

The accuracy and dispersion firings gave the following results:

Accuracy and Dispersion
Table 5

Range	Device	EVD	MVD	VSD	EHD	MHD	HSD	ES	MR	CI	
										H	V
500	Stationary	1.4	0.5	0.5	1.9	0.4	0.6	2.0	0.7	0.2	-0.3
500	Rotated	2.8	0.8	1.0	3.7	1.0	1.2	3.7	1.4	-0.2	-1.2
1500	Stationary	9.6	2.1	2.8	5.9	1.4	1.8	10.2	2.8	2.6	-1.5
1500	Rotated	12.5	3.2	4.2	9.7	2.7	3.4	14.0	4.7	2.1	-3.9

The firings indicate that the accuracy is twice as good and the dispersion is half as much when the device is left in the gun barrel as when the device is removed after each shot.

It might be pointed out that there are several design approaches which could be used to reduce the dispersion resulting from the use of a different firing device for each firing. These designs would need to be tested by conducting accuracy and dispersion firings.

The drop test portion of the EDT indicated that, although the Caliber .50 M48A1 Spotting Tracing Round is classified as neither drop safe nor bore safe, there was no detonation or combustion of the round when it was dropped 5 feet onto a steel plate. In addition, when the M48A1 Round was assembled in the bolt, the subassembly was dropped 5 feet and did not detonate or burn. To check the completely assembled device, it was dropped 5 feet onto a steel plate. The device fired the M48A1 Round into the steel plate. The firing pin was redesigned and the firing pin spring was strengthened. When the new firing pin and firing pin spring were tested, the device did not cause the M48A1 Round to burn or detonate.

CONCLUSIONS AND RECOMMENDATIONS

Contact with those who conducted the field test in Europe indicated a generally favorable reaction. The device adds realism, system test, training value, crew proficiency measurement and gunfire range computer training for those tank companies which use the device. The field evaluation report recommended that each tank company in Europe be issued five (5) of the training devices. The following points were made:

1. Realism. Because the 105mm Subcaliber Training Device has the same characteristics as service ammunition, to include hitting any target you are engaging, all members of a tank crew are required to perform every crew duty necessary in firing regular service ammunition. Maximum training value is derived by all crew members in performing each of their duties.

2. All Tank Systems Tested. All tank firing systems have to be fully operational to fire Table VII at Range 6 with the 105mm Device. All procedures, to include boresighting and zeroing of the main gun, are performed by the crew exactly as is done with service ammunition.

3. Overall Training Value and Cost. The 105mm Device trains all members of a tank crew simultaneously to fire main gun rounds at a nominal cost. Since loaders are normally new men in a tank unit in the grade of PFC (E-3) or less, the training derived from having to physically load the M73 machine-gun and main gun increases proficieny significantly.

4. Crew Deficiency Measurement. All crews can be graded as to their efficiency, speed, and expertise by using this Device. Since all three tank weapons systems are used, graders can determine and measure, by means of crew cuts, all good and bad characteristics of a tank crew in the same manner as if they were firing service ammunition.

5. Computer Training. If a gunner is made to index different types of ammunition into his computer before each main gun engagement, he will be forced to change the computer each time he fires or end up missing the target. This will enable him to develop the habit of indexing the correct ammunition into his computer each time he fires.

6. Burst-on-Target. The 105mm Device is an excellent aid in teaching gunners the correct burst-on-target methods for achieving second-round hits.

7. The weapons system was found to be accurate to 1000 meters in tank-to-target range.

8. Tank Commanders are required to range properly and constantly check subsequent coincidence reticle adjustment to be successful in achieving target hits.

The information extracted from the USAREUR Staff Study indicates the 105mm Subcaliber Training Device has substantial potential as a training device

which will increase tank crew training and capability. Further development is recommended. Improvement in rapidity of shots fired and an unlimited number of shots fired consecutively could be made. In addition, a better trajectory correlation between the Gunfire Range Cam and the bullet's flight path can be made so that accuracy from 500 meters to 1500 meters could be obtained.

APPENDIX A

APPROVED TEST PLAN

I DESCRIPTION:

A .50 caliber spotting round, barrel and breech mechanism has been adapted inside an M393 HEP-T 105MM round type body. The main gun firing circuit fires an electrical primer which actuates a mechanical firing pin to fire the percussion primer of the .50 caliber spotting round.

II TEST OBJECTIVE:

Provide comment and recommendations regarding safety of the 105MM Subcaliber Training Round for firing and usability for further field evaluation by USAREUR.

III PRIOR TESTING:

Preliminary tests have been conducted by the Infantry and Aircraft Weapons Division, Materiel Testing Directorate, APG. The test results are available for your use.

IV SECURITY CLASSIFICATION:

Unclassified.

V SAFETY:

Normal when working with small arms ammunition.

VI TEST SCHEDULE:

Test items will be available 1 July 71. Tests to be completed by 27 August 1971.

VII REPORT:

Letter Report, 10 copies forwarded to USALWL.

VIII TEST PLAN:

1. INTRODUCTION

The 105MM Subcaliber Training Rounds will not be lubricated. The rounds will be designated APG numbers 1 through 5.

2. REMOTE FIRING

2.1 Objective

To reasonably assure that weapons undergoing test will not subject test personnel to more than a minimum risk consistent with the nature of the test items.

2.2 Method

The method used is in accordance with test procedures set forth in paragraph 6.2.2 of USATECOM MTP 3-2-504. Each test weapon will have three (3) proof rounds and thirty (30) standard M48A1 rounds fired from it.

2.3 Data Required

Applicable portions of paragraph 6.2.2 of MTP 3-2-504.

2.4 Test Items Required

Four (4) 105MM Subcaliber Training Rounds will be required for this subtest The fifth unit will be used for Accuracy and Dispersion Tests.

2.5 Ammunition Requirements

Fifteen (15) proof rounds and one hundred twenty (120) M48A1 rounds are required for this subtest.

3. ACCURACY, DISPERSION, AND VELOCITY

3.1 Objective

To determine accuracy, dispersion, and velocity characteristics of the 105MM Subcaliber Training Rounds.

3.2 Method

Fire three (3) 10-round groups at 500 and 1500 yard targets with the 105MM Subcaliber Training Round at controlled rotation of 36° for each round. Fire three (3) 10-round groups at 1500 yard target with shell in position 0 (i.e., not rotated).

3.3 Data Required

X and Y coordinates of each impact relative to the initial aiming point will be recorded to provide the following for each 10-round target and overall average for each three (3) 10-round target:

a. Mean Radius
b. Center of Impact
c. Extreme Horizontal Dispersion

d. Extreme Vertical Dispersion
e. Extreme Spread
f. Mean Vertical Deviation
g. Mean Horizontal Deviation
h. Vertical Standard Deviation
i. Horizontal Standard Deviation

Instrumental velocity data will be recorded to provide the following:

a. Maximum
b. Minimum
c. Extreme Variation
d. Standard Deviation
e. Average

3.4 Test Items Required

One 105MM Subcaliber Training Round will be required during this test.

3.5 Ammunition Requirements

One hundred twenty (120) M48A1 rounds will be required for this subtest.

4. SUPERELEVATION THROUGH CAM

4.1 Objective

To determine the accuracy of the M48A1 cam in the M13 computer in supplying proper superelevation data to the gun system when the weapon is laid to fire at a given range.

4.2 Method

The method used is in accordance with test procedures set forth in USATECOM MTP 3-2-700.

4.3 Data Required

Applicable portions of 6.3.2 of MTP 3-2-700.

4.4 Test Items Required

One 105MM Subcaliber Training Round will be required for this subtest.

4.5 Ammunition Requirement

As required.

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